TECHNICAL ARTICLE

Health Hazards in the Arts and Crafts

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ABSTRACT

Toxic chemicals commonly found in art materials pose potential health risks for unaware artists. These health risks, ranging from minor skin irritation to serious damage to kidneys, lungs, heart and other vital organs, can be minimized through prevention and simple precautions. This article discusses various hazardous chemicals found in common art materials and the ways in which these chemicals can enter the body, along with various factors that influence the degree of risk to an artist. Precautions that should be taken are outlined.

Artists, whether professionals, teachers, hobbyists or children, are often exposed to a wide variety of hazardous materials and chemicals in their art- and craft-making endeavours. Unfortunately, artists often use chemicals without taking adequate precautions. Some artists are unaware that they are exposing themselves and, if working at home as many artists do, also exposing their spouses and children to these hazardous materials.

Background

In 1982, Canada's Department of National Health and Welfare initiated a Safer Arts Program dedicated to promoting awareness of health hazards in art and craft materials. The aim was to inform and educate artists by distributing published materials, presenting lectures and providing sources of advice and information.

One of the program's first projects was a series of 10 posters illustrating information relating to a variety of forms of arts and crafts including painting and printmaking, dyes and fibres, pottery and ceramics, stained glass and glassblowing, metal working, jewelry and enamelling, sculpture, woodworking, photography, and also general awareness. These posters were so popular that the information was expanded and published as a booklet, *The Safer Arts* [1]. In 1992, the Department of National Health and Welfare plans to publish five additional short booklets on health risks encountered in jewelry-making and enamelling, photography, printmaking, woodworking, and printing and drawing.

The current mandate of the Canadian Safer Arts Program also includes an emphasis in health and safety awareness for children, parents and teachers regarding arts programs. The first phase of this project, a survey of elementary school art programs, is already under way. The information gathered from this survey will be used in preparing a booklet devoted specifically to art safety for children.

Hazardous Chemicals and Routes of Entry

Chemicals in art materials can enter the body through skin contact, inhalation or ingestion. The Appendix lists various types of art and craft work and hazardous chemicals commonly used in each. Possible effects from exposure range from minor irritation to generalized illness and serious organ damage.

Contact with chemicals can affect the skin directly, resulting in skin irritation and allergies. Solvents such as methyl alcohol, toluene and turpentine can be absorbed through the skin into the bloodstream and affect other parts of the body, such as the central nervous system. In addition, when the skin is broken by cuts, burns or rashes, chemicals that might not normally penetrate the skin's protective barrier can often do so, causing damage.

Similarly, airborne materials can affect the lungs directly or become absorbed in the bloodstream through the lungs. Airborne materials of concern include: solvent vapours from paints, inks, and thinners; spray mists from airbrush and aerosol spray cans; gases and fumes from photographic baths, pottery kilns and welding; metal fumes from soldering, welding and metal casting; and dusts from dyes, pigments, pottery glazes, woodworking and grinding.

Deliberate ingestion of hazardous materials is a serious concern with young children. Adults can also be adversely affected by eating, drinking, smoking or applying makeup in the studio, where art materials may have contaminated food, drink, cosmetics, etc. Habits such as putting paintbrushes in one's mouth and nailbiting during work can also result in the ingestion of toxic art materials [2].

Acute effects appear after a single exposure, for example, skin burns from contact with concentrated acids. Because of the swift onset of symptoms, it is fairly simple to relate the exposure source to the health problems. Chronic effects develop after months, years or even decades of exposure to a chemical, often at fairly low concentrations. Chemicals that cause chronic problems are much more difficult to identify. For example, silicosis—an illness caused by ex-

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posure to silica, such as is found in clays, sandstone and soapstone—normally takes at least 10 years to develop.

Risk Factors

A variety of factors determine the degree of risk involved when working with your art materials. These include the following:

1. Toxicity: the more toxic a material is, the less required to cause bodily harm.
2. Amount of material: the larger the amount of material used, the greater the risk.
3. Length of time and frequency of exposure: there is a much greater risk when working with a potentially hazardous chemical for 8 hr daily than there is from working with it for 30 min daily; the risk is much greater when working for 30 min daily than for 30 min every other day.
4. Conditions of exposure: the precautions taken when working with a chemical will determine the degree to which it can cause bodily harm.
5. Total body burden: the *total* body burden of a chemical is the total amount to which a person has been exposed, from *all* possible sources, including food, water and air, in addition to art materials.
6. Multiple exposures: exposure to more than one chemical at a time can involve additive effects, in which the combined effect is the sum of the effects from separate exposures to different chemicals. Multiple exposures can also cause a more serious synergistic or multiplicative effect, in which the damage from exposure to two or more chemicals is much greater than would be anticipated from the separate exposures to individual chemicals.
7. Susceptibility: two people exposed to the same chemical under the same conditions may react differently due to individual susceptibility, which varies with age, health, individual physiology and total body burden. Children, pregnant women, people with temporary or chronic illnesses or allergies (especially asthma), people taking medications, and the elderly are susceptible to adverse effects from many materials that pose little risk to the general adult population.

General Precautions

Choose the Safest Materials Possible

Whenever possible, use water-based rather than solvent-based materials, water-based glazes rather than dry powders, and wet, already prepared materials, i.e. prepared clay, rather than a dry mix. Also, avoid highly toxic materials.

Read Labels Carefully

Unfortunately, most labels only list the acute or immediate hazards, although laws in various countries are beginning to require that long-term effects also be listed. For more complete information, request Material Safety Data Sheets (MSDSs) from the distributor or manufacturer for supplies and products. MSDSs contain information about the chemical composition, health and fire hazards, incompatibilities, decompositions and use precautions of a product.

Set Up Your Studio Carefully

Whenever possible, do not have a studio in your home. If you must work at home, set up your studio in a separate room, not in the living areas. Store your art materials safely, where children cannot reach them. Do not store materials in food or drink containers, such as orange juice containers or soda bottles, to prevent accidental ingestion.

Provide Adequate Ventilation

There are two types of ventilation for controlling toxic contaminants: dilution ventilation and local exhaust ventilation [3]. Dilution ventilation brings clean air into the room, mixes it with the contaminated air, dilutes it to a lower, and safer, concentration, and then exhausts it to the outside through an exhaust fan. This type of ventilation is good when working with small amounts of solvents or gases that are low in toxicity, for example, oil painting or black-and-white photographic processing. Local exhaust ventilation uses hoods, spray booths and other equipment to capture the contaminants where they are generated—before they can get into the general room air. The contaminants are then exhausted to the outside through ducts. Local exhaust ventilation is the better system of these two choices.

Protect against Fire

Do not smoke or work with open flames, sparks or static electricity near flammable liquids or gases. Store flammable and combustible liquids in safety cans and keep on hand only small amounts needed for just a few days. Large amounts of flammable and combustible liquids should be stored in a flammable-materials storage cabinet. Install smoke alarms and furnish the studio with proper fire extinguishers and know how to use them. For ordinary combustibles, flammable liquids and electrical equipment, a class ABC fire extinguisher is appropriate. If using flammable liquids, the exhaust ventilation system must be spark-proof.

Clean Up Carefully

Always clean up spills immediately. For chemical dusts, use a wet mop or vacuum cleaner; never dry-sweep as this stirs up dust. For highly toxic dusts, the vacuum cleaner should be equipped with a special High Efficiency Particulate Air (HEPA) filter.

Dispose of Art Materials Safely

Do not pour solvents down the sink. Small amounts—less than a pint—can be disposed of safely by evaporation inside a local exhaust hood or outdoors. For large amounts, contact a waste disposal service. Many aqueous solutions can be poured down the sink, one at a time with lots of water. Acids and alkalis should be neutralized first. Check with local or provincial environmental authorities for regulations.

Maintain Good Personal Work Practices

Do not eat, drink or smoke in the studio. Wash chemical splashes off your skin with lots of water. In case of eye contact rinse with water for at least 20 min and call a doctor; an eyewash fountain is recommended. If you are using concentrated acids and alkalis, you should also have an emergency shower. Do not wash hands with solvents. Remove oil paints with baby oil, then use soap and water. Keep a first-aid kit available.

Wear Proper Protective Clothing and Equipment

Wear special work clothes (smocks, hair coverings, etc.) and wash them separately from other clothing. When necessary, use the right type of gloves, goggles, hearing protectors, respirators or other protective gear, making sure they are approved for the materials you are using and that they fit properly. Respirators in particular should be approved by the National Institute for Occupational Safety and Health (NIOSH) for the material you are using.

Avoid Physical and Electrical Hazards

Put machine guards on all machinery. Do not wear loose, long hair, loose sleeves, or jewelry around machinery. Keep equipment and electrical wiring in good repair.

Seek Medical Assistance

If you experience symptoms that might be associated with the use of art materials, seek expert medical assistance. A general physician might not have expertise in this area since specialized training is needed to understand the toxic effects of chemicals. A visit to an occupational health physician might be necessary.

APPENDIX: HAZARDOUS CHEMICALS FOUND IN ART MATERIALS

Ceramics

Clay: silica, asbestos (in talc)
Glaze components: compounds of lead, barium, lithium, strontium
Colorants: compounds of antimony, cadmium, chromium, cobalt, copper, gold, manganese, nickel, palladium, platinum, selenium, silver, vanadium, uranium, etc.
Kiln gases: carbon monoxide, chlorine, fluorine, formaldehyde, nitrogen oxides, sulfur dioxide

Commercial Art

Rubber cement and thinner: hexane, 1,1,1-trichloroethane
Aerosol sprays: hexane, methylene chloride, petroleum distillates, toluene, 1,1,1-trichloroethane, xylene, etc.
Felt-tip markers: xylene, propyl alcohol, dyes
Airbrush materials: see Painting, *pigments*

Enamelling

Arsenic, lead, fluorine compounds: sodium bisulfate (produces sulfur oxides); see also Ceramics, *colorants*

Fibre Arts

Dyes: fibre-reactive dyes, azoic dyes, benzidine-type dyes, basic dyes, disperse dyes, direct dyes
Acids: acetic, formic, oxalic, sulfuric
Mordants: ammonia, bichromates, copper sulfate, stannous chloride
Miscellaneous: methyl alcohol, sodium hydrosulfite (produces sulfur dioxide), molds, bacterial spores or spores of *Bacillus anthracis*

Metal Sculpture/Jewelry

Acids: nitric acid, sulfuric acid, sodium hydrogen sulfate
Molding materials: asbestos, free silica, formaldehyde resins, isocyanates (polyurethane resins), wax fumes
Metal fumes: aluminum, antimony, boron, cadmium, chromium, copper, iron, lead, manganese, nickel, silver, tin, zinc, etc.
Metal patinas: acetic acid, ammonium chloride, ammonium sulfide, arsenic trioxide (may produce arsine), barium sulfide, copper compounds, hydrochloric acid, iodine, lead acetate, platinum chloride, potassium ferricyanide (may produce hydrogen cyanide), sulfides (produces hydrogen sulfide), zinc chloride, etc.
Other: carbon monoxide, fluorides, hydrogen chloride, hydrogen cyanide (cyanide electroplating baths and decomposition of polyurethane foams), nitrogen dioxide, ozone

Glassblowing

Ammonia, arsenic oxide, bifluorides, hydrofluoric acid, silver nitrate, titanium tetrachloride, vanadium tetrachloride; see also Ceramics

Painting

Solvents: ammonia, ethyl alcohol, formaldehyde, methylene chloride, mineral spirits, toluene, turpentine, xylene
Pigments: barium chromate, barium manganate, cadmium sulfide, cadmium selenide, chromic oxide, cobalt arsenate, cobalt oxide, cobalt phosphate, lead carbonate, lead chromate, manganese ammonium phosphate, manganese dioxide, mercuric sulfide, strontium chromate, zinc chromate
Other: ammonia, formaldehyde (trace)

Photography

Black-and-white processing: acetic acid, bisulfites (produces sulfur dioxide), boric acid, bromides, chromic acid, formaldehyde, hydroquinone, hypo (ammonium or potassium thiosulfate produces sulfur dioxide), monomethyl p–aminophenol sulfate, phenidone, potassium chrome alum, pyrogallic acid, and sodium hydroxide
Color processing: benzyl alcohol, glycol ethers, formaldehyde, hydroxylamine sulfate, para-phenylene diamine developers, sulfamic acid; see also *black-and-white processing*
Toning solutions: bisulfites (produce sulfur dioxide), gold chloride, selenium dioxide, sulfides (produce hydrogen sulfide), thiourea, uranium nitrate
Reducers and intensifiers: cyanide salts (can produce hydrogen cyanide), dichromate salts, hydrochloric acid, iodine, mercuric chloride, potassium chlorochromates, potassium ferricyanide (can produce hydrogen cyanide)

Printmaking

Acids: acetic acid, hydrochloric acid (can produce chlorine), nitric acid (produces nitrogen dioxide), phosphoric acid
Pigments: see Painting, *pigments*
Solvents: alcohols, ethylene glycol monobutyl ether, ethylene glycol monomethyl ether acetate, hexane, isophorone, kerosene, ketones, mineral spirits, toluene, 1,1,1-trichloroethane, turpentine, xylene
Other: carbon arc fumes (copper fumes, nitrogen dioxide, ozone, rare earth fumes), dichromates, phenol, rosin, silver nitrate, sodium hypochlorite bleach, asbestos (in talc)

Plastics Sculpture

Resins: amines, benzoyl peroxide, epoxy, formaldehyde, glycidyl ethers, isocyanates, methyl ethyl ketone peroxide, methyl methacrylate, organotin catalysts, phenol, styrene
Solvents: acetone, ethylene dichloride, hexane, methylene chloride, methyl ethyl ketone, mineral spirits, etc.
Plastics decomposition: carbon monoxide, formaldehyde, hydrogen chloride, hydrogen cyanide, methyl methacrylate, styrene
Other: asbestos, fibreglass, phthalates, pigments, silica

Sculpture, Miscellaneous

Asbestos (in talc), silica, wax

Stained Glass

Antimony sulfide, copper sulfate, fluorides, hydrofluoric acid, lead, lead pigments, selenium oxide, silver nitrate, zinc chloride

Woodworking

Solvents: benzene, ethyl alcohol, hexane, ketones, methyl alcohol, methylene chloride, mineral spirits, toluene, 1,1,1-trichloroethane, turpentine, xylene
Other: chromated copper arsenate, creosote, epoxy glues, formaldehyde, hardwood dusts, oxalic acid, pentachlorophenol, sodium hydroxide, sodium hypochlorite bleach

References and Notes

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